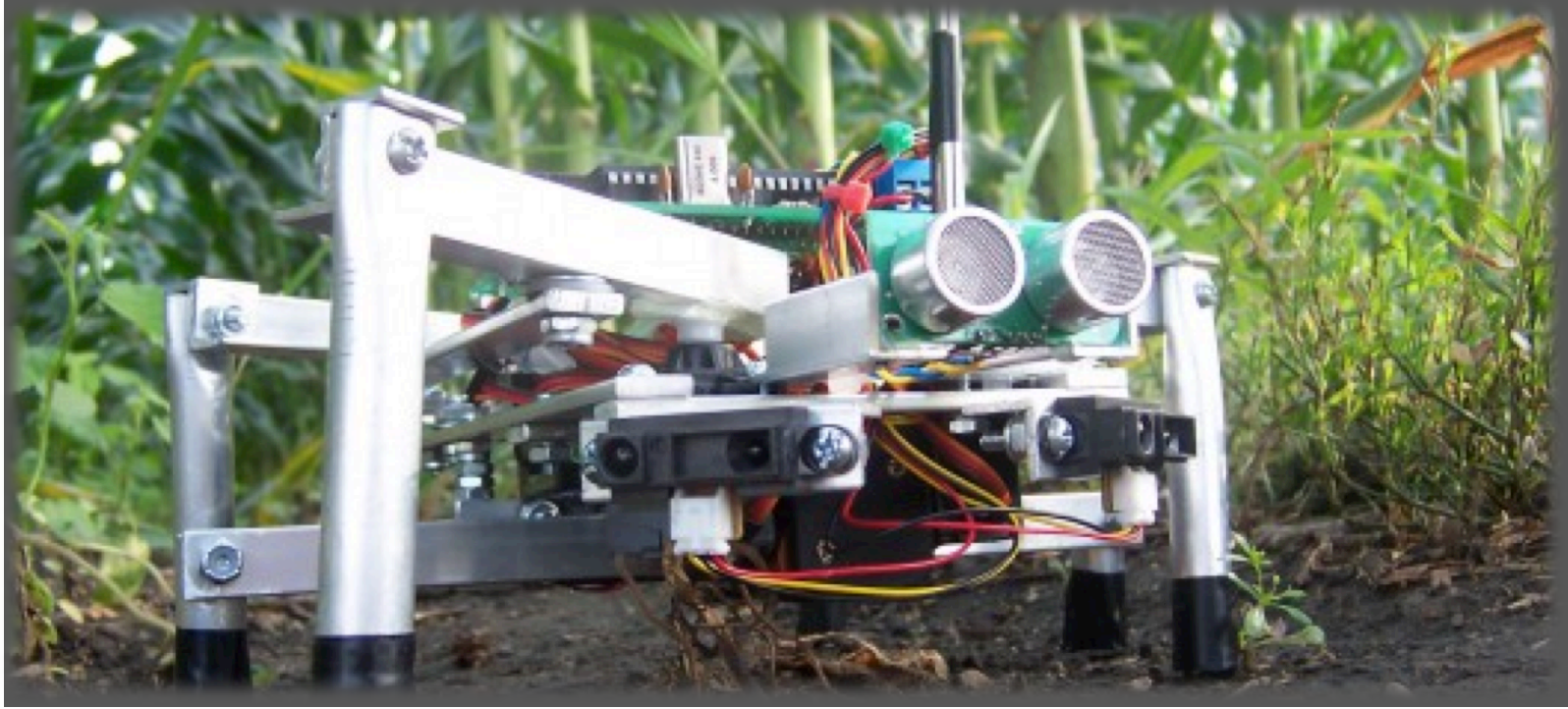

1

A VISION-BASED AUTONOMOUS ROBOTIC INTERROW-WEEDER

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Overview

- Robotic weed destruction – towards sustainable environment 
- Objective
- Challenges foreseen
- Sensing – for intelligent and autonomous robots
  - Necessary sensory information
  - Appropriate choice of sensors
  - Vision-based crop row detection
- Crop row detection – state of the art
- Planned contributions

Robotic weed destruction – towards sustainable environment

- Manual weeding

Manpower wasted

VERY EXPENSIVE!!

Robotic weed destruction – towards sustainable environment

- Chemical weeding

- Expensive
- Not environmentally friendly

Why not let the robots do the otherwise boring and expensive weeding task?

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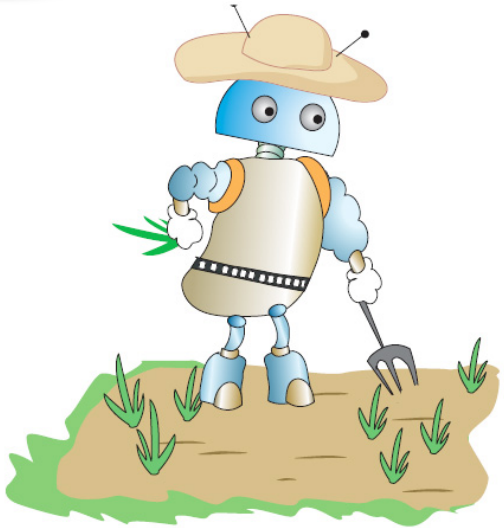
Objective

Kill weeds between the crop rows

Small

Killing weeds throughout the field



Economic

No damage to crops

Intelligent and autonomous

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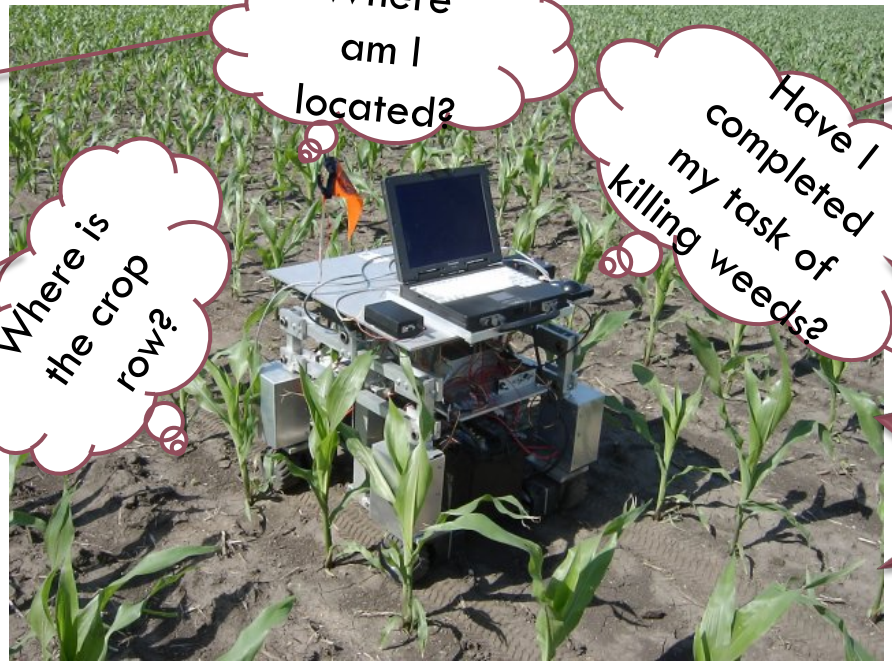
Challenges foreseen

Localization and mapping of the unknown field geometry

Accurate and robust detection of crop rows and other obstacles



Ensuring the complete coverage of the field?

How can the robot make sense of the world?

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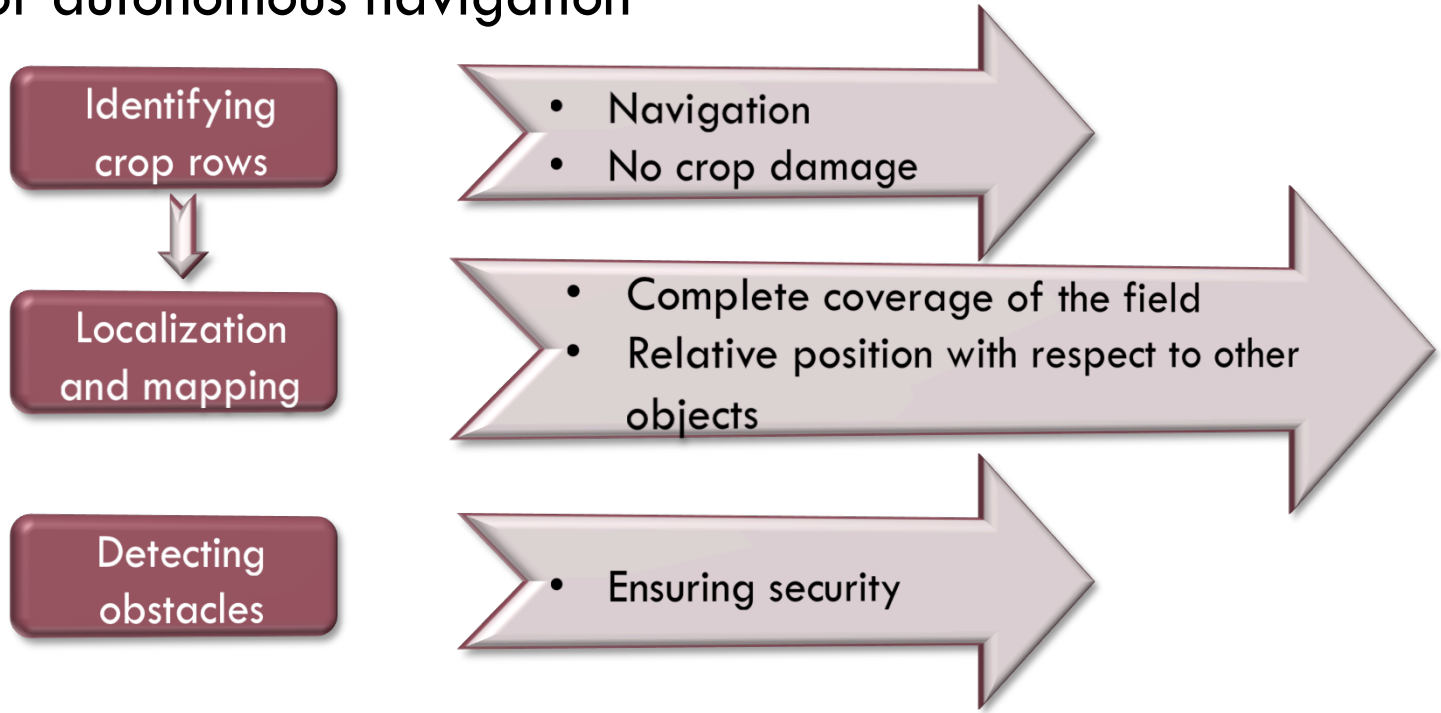
Sensing – for intelligent and autonomous robots

Necessary sensory information

- For autonomous navigation



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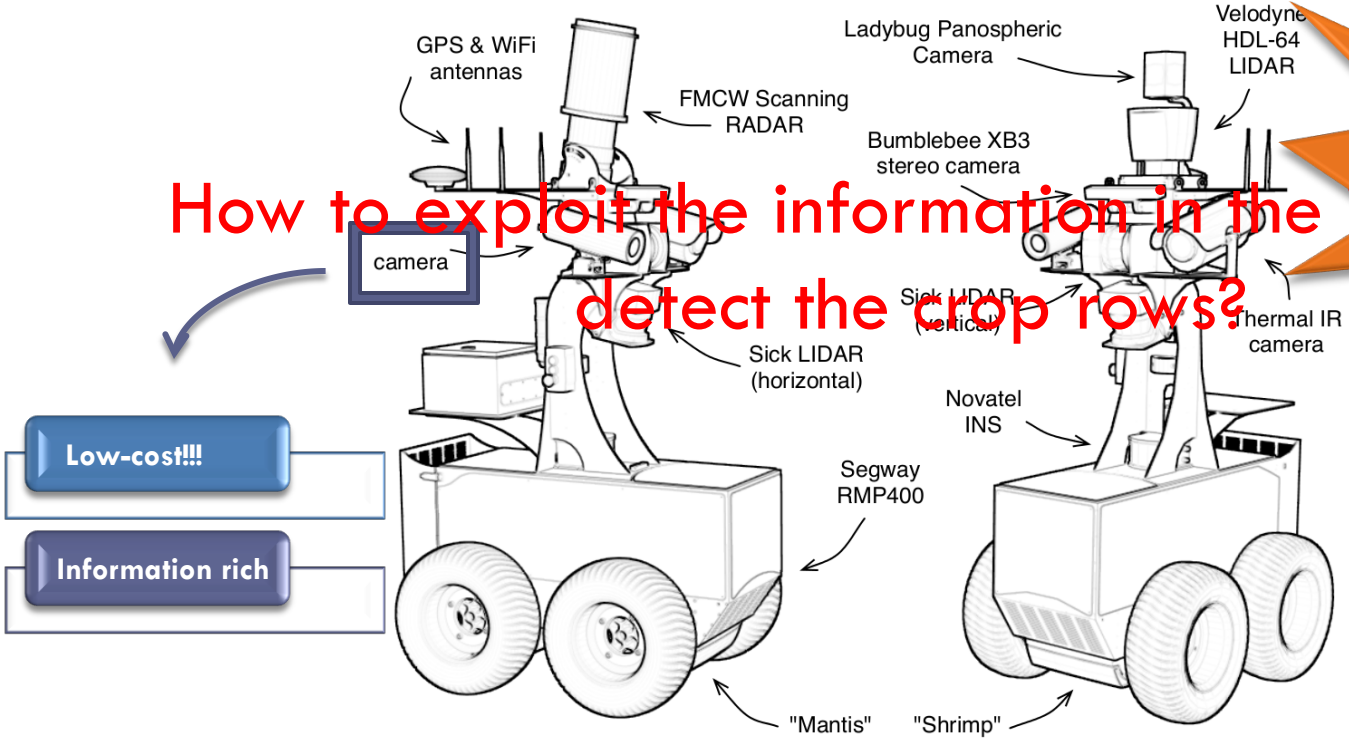
Sensing – for intelligent and autonomous robots

Appropriate choice of sensors



How to exploit the information in the images to detect the crop rows?

Sophisticated but EXPENSIVE!!

Low-cost!!!

Information rich

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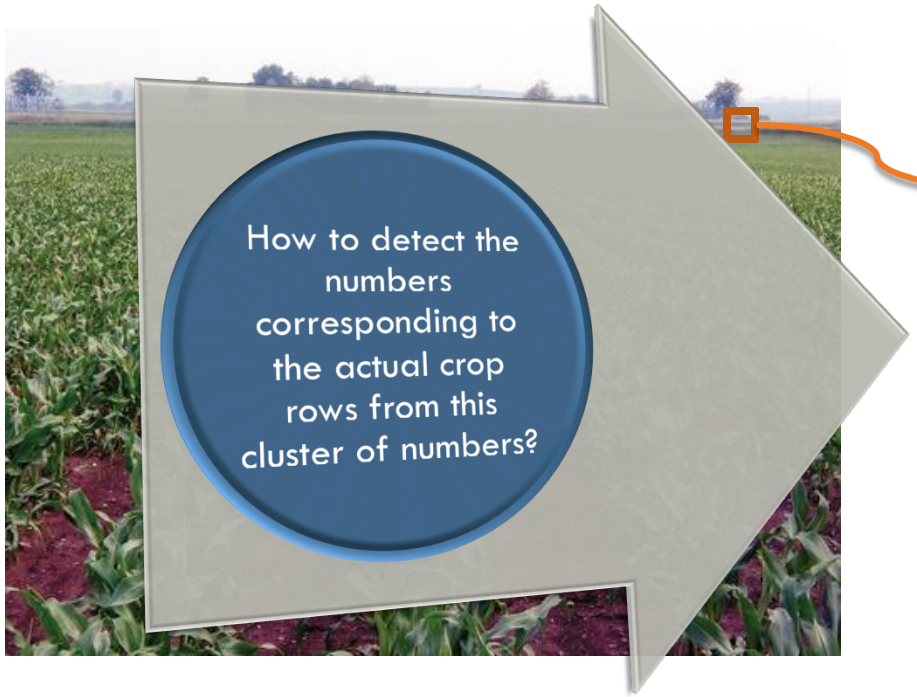
Sensing – for intelligent and autonomous robots

Vision-based crop row detection

- What we see



- What robot sees

0	3	2	5	4	7	6	9	8
3	0	1	2	3	4	5	6	7
2	1	0	3	2	5	4	7	6
5	2	3	0	1	2	3	4	5
4	3	2	1	0	3	2	5	4
7	4	5	2	3	0	1	2	3
6	5	4	3	2	1	0	3	2
9	6	7	4	5	2	3	0	1
8	7	6	5	4	3	2	1	0

Sensing – for intelligent and autonomous robots

Vision-based crop row detection

- Why is it challenging?

Shadow occluding the rows

Presence of weeds

How to cope up with the variability in this dynamic and ever-evolving environment?

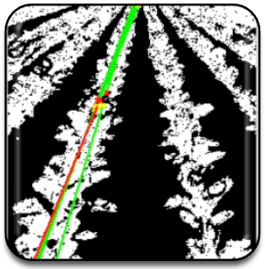
Missing crops

Crops of varying types and growth stages

Sensing – for intelligent and autonomous robots

Vision-based crop row detection

- Ideal case

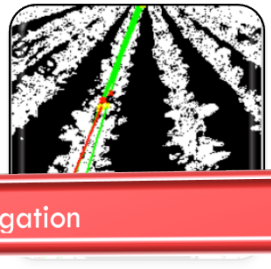


Crop rows (lines) detected by Hough transform

Pre-processing step

The position and orientation of the robot with respect to the crop row can be calculated

Plants separated from the background



Crop rows (lines) detected by Hough transform

Navigation

Localization and Mapping

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Crop row detection – state of the art

- Handling all the uncertainties of the ever-evolving real world – daunting task
- Existing works do not handle all the variabilities encountered in agriculture
  - technique handling missing crops fails when there is high weed pressure and vice versa [J. M. Guerrero et. al, 2013]
- Static predetermined chain of pre-processing techniques
  - not appropriate to handle the dynamicity of the environment

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Planned contributions

Short-term

- Enabling accurate and robust crop row detection
  - Selecting various combinations of multiple appropriate pre-processing techniques
  - Using machine learning to dynamically select the best set of pre-processing techniques for the given problem at hand
  - Hough transform and RANSAC based algorithms for fitting the lines after pre-processing
  - Kalman filter like data fusion algorithms to combine data from heterogeneous sensors if needed

Planned contributions

Long-term

- Efficient and complete coverage of the field
- Hardware and software platform implementing the robotic system
- Testing the system on an actual case study

Thank you!!